Lake County
Health Department and
Community Health Center

www.lakecountyil.gov/Health/want/ISD.htm
Population Health Services
Individual Sewage Disposal Program
847-377-8020

WASTEWATER TREATMENT AND DISPOSAL BY ON-SITE WASTEWATER TREATMENT SYSTEMS

In large areas of Lake County, properly functioning septic systems (onsite wastewater treatment systems) are essential for the protection of the public health, the environment and property values. Throughout Lake County the use of septic systems expanded rapidly after World War II as the suburban housing boom spread beyond the reach of new public sewer construction. Unfortunately, technology and regulations did not keep pace with this development.

A common assumption at the time was that the use of septic systems was only a temporary condition, and that public sewers would soon replace these systems. This model of land development provided little incentive to improve the understanding of how systems worked and how to overcome marginal site and soil conditions with new designs. The result was poorly operating systems with few options for improvement. Some areas like this still exist in Lake County.

Research by universities and government agencies into the development of alternative systems and system design expanded greatly in the 1970's. This research identified the biological, chemical and physical processes that occur in the soil and the interactions between the soil and wastewater. Alternative design technologies and management programs have been developed and are continuing to be developed for poor sites and problem areas. Some soils, however, are unsuitable for treating and absorbing wastewater and should be avoided.

The Lake County Health Department and Community Health Center, through its ordinances, plan review process, and licensing of septic system designers, installers and soil scientists, strives to insure that all system proposals have every reasonable chance of success.

The Soil and Site Determines the System

Not all soils or sites are suitable for on-site wastewater systems. **The most common conditions in Lake County that may make soils unsuitable for which there are usually no practical engineering solutions include: year-round or shallow seasonal soil saturation near the ground surface (poorly drained soil), high clay content (low permeability), past filling or scraping activities, steep slopes and past site uses.**

THE SOIL EVALUATION

Soil types are best identified by soil scientists. Soil scientists are individuals trained in the use of standard methods used throughout the country for soil identification. There are 36 documented naturally occurring soil types in Lake County. More types exist intermingled among these. A certain soil type is not necessarily suitable or unsuitable in every location

where it is found because soils are identified according to ranges of characteristics.

This is one reason why a soil test should always be performed before a lot or parcel of land is purchased. Percolation tests (perc tests), at one time the only method used for determining soil suitability, have now been replaced by soil tests. This is because perc tests have been found to produce inconsistent results when performed at different times of the year and at different soil moisture levels. Additionally, the percolation test itself did not identify soil conditions, such as seasonal zones of saturation, that can adversely impact wastewater treatment.

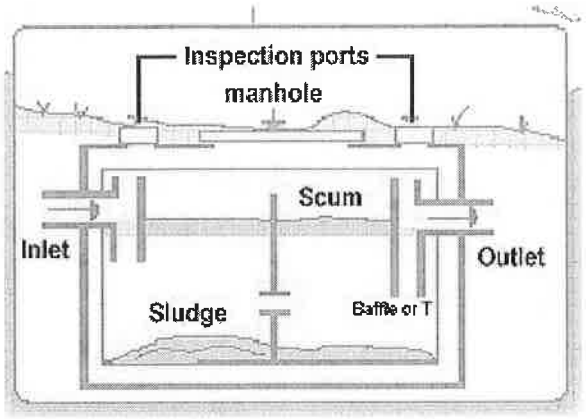
SITE CONDITIONS

Even if a lot or parcel has suitable soil, it may still be unsuitable or limited for a particular use because of site factors. These problem site conditions include: topography, distance to existing and proposed water wells, distance to surface water (pond, lake, creek, wetland) and utility, drainage and conservation easements. Small lots, usually associated with older subdivisions and lake lots, commonly have these problems.

WASTEWATER PRETREATMENT

SEPTIC TANK

The septic tank is a watertight chamber, usually concrete, but plastic tanks are also available. Common sizes are 1000, 1250 and 1500 gallons. Older existing septic tanks may be smaller in size. A septic tank (trash tank) is required in almost all on-site wastewater system designs. The tank is transported to a site by a truck and set in place. Wastewater produced in the structure enters the tank through the building sewer pipe.



TWO COMPARTMENT SEPTIC TANK
Source: The National Small Flows Clearinghouse *Pipeline*, Fall 1995, Vol. 6, No. 4

In the septic tank the raw sewage separates; most solids fall to the bottom creating a sludge layer, while the greases, oils and other floating particles rise to the liquid surface forming a scum layer. Only the liquid (septic tank effluent) flows out of the tank. The baffles prevent any floating solids from leaving the tank. The tank may have one compartment, or, more typically, the tank will be divided by a wall creating a two compartment tank.

Two tanks can be placed in-line with each other to meet the minimum volume required by code. Septic tanks should be pumped out and inspected by a licensed tank pumper once every two or three years.

EFFLUENT FILTERS

An effluent filter is a device installed at the outlet of a septic tank. It can be in-

installed inside or outside of the tank. It screens and collects solids ordinarily suspended in solution. Sometimes called a horizontal plate filter or an effluent screen, these devices will extend the life of the septic field by "catching" floating particles which, if allowed to enter the system, would eventually plug the soil. Generally, the filters are cleaned when the tank is pumped by simply hosing the filter so that all material is deposited back into the septic tank, then pumped out.

AEROBIC UNIT

Another pre-treatment device is the aerobic unit. Depending on the manufacturer and the intended use, a pre-treatment tank or trash tank (small septic tank) may have to be installed before the aerobic unit. Typical sizes for aerobic units are 500, 600, 750 and 1000 gallons per day. Unlike septic tanks, aerobic units "bubble" air through the wastewater very much like a municipal wastewater treatment plant. Oxygen provided to microorganisms that are suspended in effluent or attached to a media encourage rapid degradation of wastewater constituents. Some units also filter the wastewater before it is discharged. This bubbling action and filtering treats the wastewater to a much greater degree than the processes occurring in a septic tank. **The wastewater, though relatively clear and free of odor, still contains significant concentrations of nutrients and disease causing organisms.** For these reasons, additional treatment of the wastewater is required. An audio-visual alarm mounted in a conspicuous place alerts the owner of any malfunction. For continuous operation (i.e., high level of wastewater treatment) the unit must be inspected, and if needed, serviced.

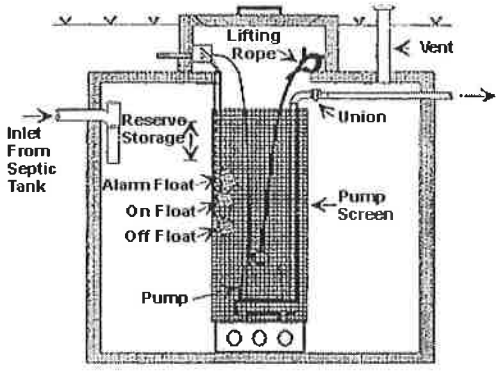
Since 1997, the Lake County Board of Health Ordinance, Article V has required all aerobic treatment units to be serviced bi-annually by a licensed service provider or manufacturer's representative. Lack of servicing could result in obstructed flow of wastewater and/or solids entering the soil absorption field.

SAND FILTERS

Sand filters are constructed beds of sand used to treat wastewater. The sand is contained in a liner made of plastic, concrete or impermeable soil, and provides an effective fixed media for aerobic microorganisms. The filters are either single pass or multi-pass filters. Partially treated wastewater is applied to the sand filter surface in intermittent doses and receives treatment through the sand. In most sand filters, the wastewater then collects and flows to further treatment and/or disposal. Sand filters typically are used as the second step in wastewater treatment after solids in the wastewater have been separated out in a septic tank or aerobic unit. Wastewater treated by sand filtration is usually colorless and odorless, but may still contain significant concentrations of nutrients and disease causing organisms. For these reasons, additional treatment of the wastewater is required.

LIFT STATION

When the building sewer leaving the house is lower than the wastewater disposal system or when a pressurized system is used, a lift station (dosing chamber) is required. A lift station is a watertight concrete chamber similar in construction to a septic tank. It is placed between the septic tank or aerobic unit and the soil absorption field. Wastewater flows into the lift station from the septic tank or aerobic unit and is transported to the soil absorption field by a pump.



LIFT STATION

The pump sits elevated above the bottom of the lift station and cycles periodically, pumping out a specific volume of wastewater each time. The pump has three float switches: on switch, off switch, and a high water alarm. A manhole, providing access to the pump, is required to be at the ground surface. An audio-visual alarm is mounted in a visible place to alert the owners of a pump malfunction.

A lift station is needed for all low pressure pipe, at-grade and mound systems. This is because these system types use low pressure distribution pipes.

TYPES OF SYSTEMS

There are four main system types used in Lake County:

Conventional (Types 1 and 2)

Low Pressure Pipe (Type 3)

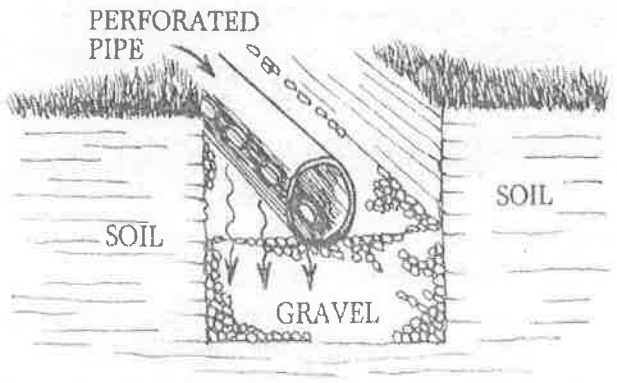
At-Grade (Type 4)

Mound (Type 5)

The system that must be used on a particular site is determined by the soil conditions. The two most important soil characteristics are depth to seasonal soil saturation and permeability. Soil scientists carefully evaluate these at the time of the soil test by examining soil profiles. In most cases, the depth to soil saturation cannot be effectively manipulated by drainage technology. Very little, if anything, can be done to change soil conditions without running the risk of destroying the area needed for the wastewater disposal system. **The existing soil conditions determine the type of system that must be used.**

CONVENTIONAL SYSTEM
TYPES 1 AND 2

The most basic type of on-site wastewater system is the gravity flow conventional system. It has two components: a septic tank and a soil absorption field usually consisting of a series of gravel-filled trenches called seepage trenches (often called drainfield, seepage field, septic field). The soil absorption field could also be a seepage bed. For proper treatment and disposal of wastewater, conventional systems require well-drained soils.



CONVENTIONAL TRENCH
Source: www.tvseptic.com

A trench is typically 2 to 3 feet wide and contains a 4 inch perforated pipe with at least 6 inches of gravel below the pipe and 2 inches of gravel above the pipe.

The top of the gravel is covered with building paper or synthetic fabric, and at least 6 inches of soil. Trenches must be installed following the existing topography (parallel to contour). The only difference between System Types 1 and 2 is the depth of trench into existing grade.

The seepage trenches in a gravity-flow conventional system are typically designed as a serial distribution (drop box) system. Wastewater enters each trench through a drop box. In the past, serial distribution systems were allowed to be constructed with sand fill (Fill System). Varying depths of fill were used, ranging between 8 and 15 inches.

When a serial distribution system is first put into use, the highest trench receives, and must absorb, all the wastewater. This overloading forces the soil to progressively clog. When the clogging becomes severe enough, water will pond in the trench, reach a certain depth, and then spill over to the next trench immediately downslope. The second trench must now absorb most of the wastewater. It will eventually clog like the first trench causing wastewater to spill to the third trench. This progressive clogging will continue until all the trenches are full, and seepage to the ground surface will likely occur out of the lowest trench. The water level in each trench can be checked by digging down to the drop box and lifting the cover.

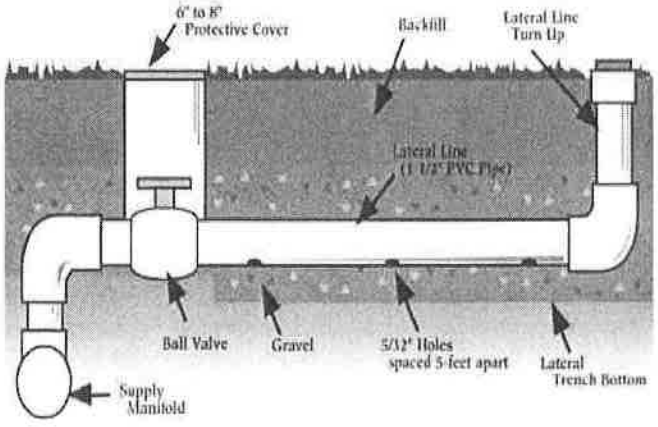
The conventional system design can be modified by using an aerobic unit in the place of the septic tank. If properly maintained, the aerobic unit has proven to extend the life of the seepage trenches.

Sometimes, a lift station will be needed in a conventional system because the seepage trenches will be higher in elevation than the structure's building sewer.

LOW PRESSURE PIPE
SYSTEM TYPE 3

Low pressure pipe (LPP) systems use a similar trench design as a conventional system. Rather than constructing all of the trench in existing soil, the trench is partially installed in a coarse sand (torpedo) that has been spread over the entire soil absorption area.

The depth of fill is a minimum of 10 inches. These systems require the use of a lift station because of the piping used in the system. Wastewater is distributed in each trench by small diameter pipes (1 ¼ -2 inches) having small holes (3/16-1/2 inches) at specific spacing. From the lift station a certain volume of wastewater is pumped to the pipes in the gravel trenches. The wastewater fills the pipes and is evenly distributed to the trenches through the small holes.



CROSS SECTION OF A LOW PRESSURE PIPE TRENCH
www.watershedcommittee.org

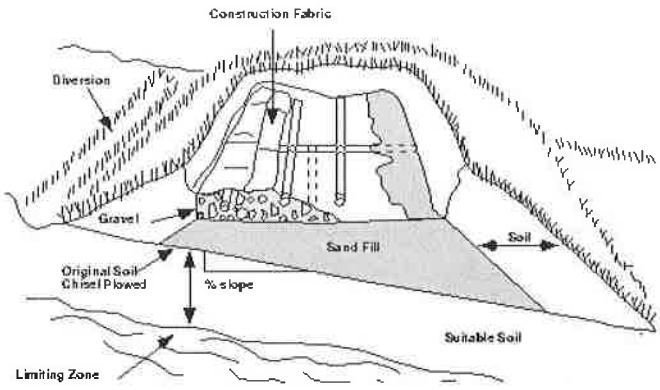
The advantages of the LPP design over the conventional serial distribution system are equal distribution of wastewater to each trench and intermittent pumping. Each square foot of trench receives the same amount of wastewater when the pump is on. When the pump shuts off, the water in the trenches seeps into the soil. The trenches and soil are given time to drain before the pump cycles again. This intermittent pumping or "dosing" prevents water from ponding in the trenches and greatly reduces soil clogging. An aerobic unit is required, per code, for all LPP system installations.

WISCONSIN MOUND
SYSTEM TYPE 5

The Wisconsin mound was developed at the University of Wisconsin-Madison and first put into commercial use in Wisconsin in the mid-seventies. Numerous states have since approved its use. Mounds were developed because there was a need to have a system that would provide environmentally sound treatment and disposal of wastewater on soils poorly suited for absorbing wastewater. Research and monitoring into improved siting and design of the mound continues to this day. For successful and predictable treatment and disposal of wastewater, mounds require at least 12 inches of existing, unsaturated, suitable soil.

Mounds resemble berms when constructed. They consist of a mound of sand with a gravel bed or trench capped with at least 12 inches of soil cover. At their highest point they are about 34 inches high. **The length of the mound must follow the contour of the existing ground, consequently their shapes can vary.**

Mounds utilize the principle of **equal distribution.** From the lift station, a specific volume of wastewater is pumped up into the pipes in the gravel bed.



WISCONSIN MOUND
Source: www.engineering.usu.edu/uwr/training

The bed is elevated at least 12 inches above the existing ground surface by sand. The wastewater fills the pipes and is evenly distributed through the small holes. The wastewater flows down through the gravel and sand, enters the original soil at the plowed layer. It then flows mainly horizontally away from under the mound, following the layers in the original soil. The wastewater is treated as it flows through the sand and the original soil.

AT-GRADE SYSTEM
SYSTEM TYPE 4

This system is very similar to the mound system. The major difference is that no sand is needed. The gravel bed is placed directly on the plowed soil surface following contour. Sand is not required because the depth of existing, unsaturated, suitable soil is sufficient. Other aspects of this system are the same as the mound. Equal distribution and small diameter pipes are used, and a lift station is required.

All of the preceding systems may use an aerobic unit instead of a septic tank. Depending on the system type, this substitution reduces the minimum soil requirements needed for complete wastewater treatment.

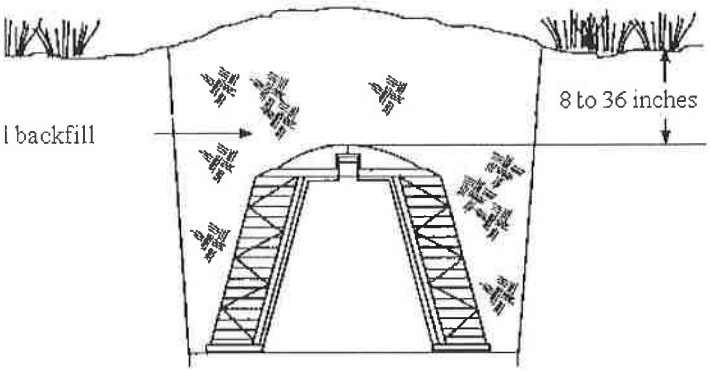
OTHER SYSTEM DESIGNS

SURFACE DISCHARGING SYSTEMS

In a surface discharging system, there is no soil absorption of wastewater. Wastewater is discharged directly to a body of water providing sufficient dilution. Before being discharged the wastewater undergoes pretreatment through an aerobic unit, a sand or peat filter, or a constructed wetland, with disinfection (usually chlorination or ultraviolet light) as the final step. For proper operation these systems require constant maintenance throughout the year. Surface discharging systems have not received widespread acceptance from public officials and the on-site wastewater industry because of the long term nuisance and potential public health hazards they can create when neglected. As a result, there are a small number of these systems in Lake County, and they are routinely inspected and sampled.

SEEPAGE CHAMBERS

The seepage chamber is not really a different type of system but rather is used as a substitute for the gravel in conventional systems. Each chamber section is approximately 6 feet long and 1 foot high, and is constructed of polyethylene (plastic). The sections vary in width between 15 and 36 inches and are horseshoe shaped. Sections are placed directly on the soil where gravel would normally be placed, and are connected together to the desired length.



CHAMBER SYSTEM
Source: www.ianrpubs.unl.edu/

The manufacturers suggest that since none of the soil surface is covered with gravel, more soil surface area is available to absorb wastewater. Seepage chambers are often used for system repairs on sites where access with construction equipment over the system area is difficult.

NEW TECHNOLOGIES

New technologies focusing on improving the treatment and disposal of wastewater are constantly being developed. Peat biofilters and drip distribution are two such systems.

PEAT FILTERS

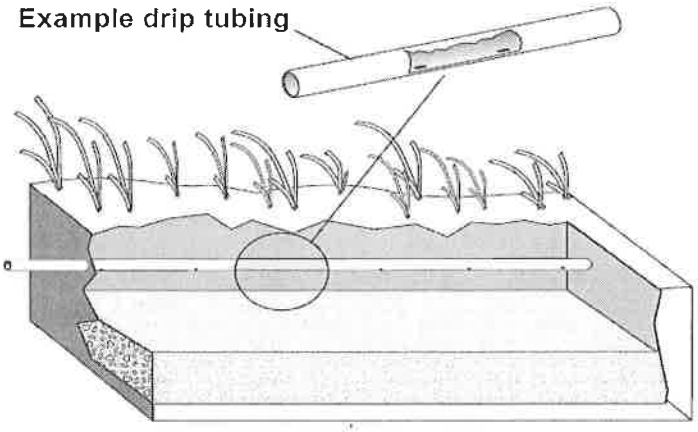
A typical peat filter consists of loose or bagged peat inside a fiberglass container. Wastewater is pumped to the top of the peat and distributed evenly over the surface of the peat through a series of perforated pipes. The peat used in these filters is similar to the peat moss used in gardening but has been processed in some manner to improve per-

meability. Treatment of the wastewater occurs through a combination of physical, chemical and biological interactions as it flows down through the peat. Reduction in the organic waste matter and bacteria contents of wastewater is reported to be in the upper 90 percent range. After the peat filter, the wastewater must have a final disposal point. The method of disposal depends on the site and soil conditions present on the property.

Manufacturers are introducing new fixed -media treatment systems too rapidly to describe adequately. Plastic balls, sponge cubes, brick chips, expanded shale, fabric, wetland plant beds, and various proprietary materials are available to address specific wastewater treatment requirements.

DRIP IRRIGATION

Drip irrigation technology was originally developed for agriculture. It is an ideal method to evenly distribute water in soil at very low rates, and over large areas. Applying it to wastewater disposal requires the wastewater to be relatively free of clogging agents such as suspended material, fats, oils and greases. The use of aerobic units, peat filters and sand filters accomplish this. Instead of standard plastic pipes, drip irrigation systems use 1/2 inch diameter flexible polyethylene tubing (dripline). Every 2 feet in the dripline is a device called an emitter that controls the flow of water out of the dripline. Flow out the emitters is very low, typically only 0.53 gallons per hour. Such low flow prevents oversaturation of the soil. In order to achieve equal distribution and sufficient flow out the emitters, a high-pressure pump, similar to those used in water wells, must be used. Operating pressures in the system range from 7 to 60 pounds per square inch.



Source: National Small Flows Clearinghouse, *Pipeline*, Winter 1999, Vol. 10, No. 1

The dripline is installed in narrow trenches or slits, 2 feet apart and 6 to 12 inches deep. Shallow installation places the dripline in permeable soil and in the root zone of plants, thereby taking advantage of evapotranspiration. Lengths of dripline for a four bedroom house can reach 1500 lineal feet depending on soil conditions. The even distribution and low application rate of the wastewater makes drip distribution systems ideal for irregularly shaped lots, steep areas and clayey soils. The spacing of the driplines can also be varied to work around trees and landscaping. Frost protection is important in winters with minimal snow cover and excessive frost.

HOLDING TANKS

A holding tank system has no soil absorption field or other discharge point for final wastewater disposal. As with onsite wastewater systems, the holding tanks must receive all the wastewater produced in the home, including laundry water. When the tanks become full, an audio-visual alarm alerts the owner. The tanks must then be pumped by a

licensed septic tank pumper who in turn transports the wastewater to a sewage treatment plant or approved land spreading location. The frequency of pumping depends on water use and can be very expensive.

Holding tanks place the burden of wastewater treatment and disposal on municipal treatment plants, and permitted land application sites. The uncertainty of the availability of these disposal locations is one reason the Health Department does not allow holding tanks as a permanent wastewater system for new construction sites.

Holding tanks are only allowed in the repair of a failing system where an on-site sewage disposal system is not feasible, or for temporary use.

FAILING SYSTEMS

Many factors can cause a soil absorption field of a septic system to fail. **Old age failure** results from the formation of a clogging layer. This layer forms on the bottom and sides of trenches where the gravel contacts the soil. The clogging layer gradually develops to a point where wastewater cannot move fast enough into the soil. Wastewater will begin to back up, and in most cases will seep to the ground surface.

Seasonal failures are common on older seepage trench systems that are installed too deep into the seasonally saturated soil. During the wet times of the year, the trenches fill up with water from the surrounding soil leaving no available space for wastewater. The wastewater mixes with the soil water and commonly surfaces out of the lowest trench.

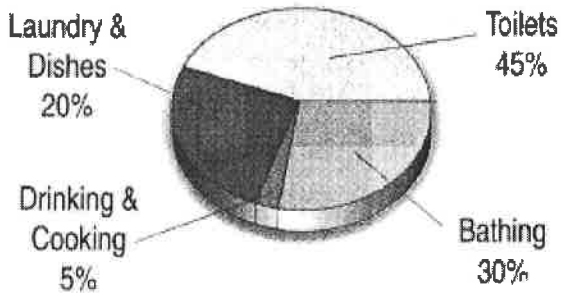
Some systems fail shortly after installation. **Poor construction practices, improper siting and poor design** are frequently the causes. Constructing a system when the soil is wet smears the soil, destroying its porosity. Driving equipment over the system area can compact the soil and also decrease its ability to absorb wastewater. Improper siting and poor design can be prevented by careful planning and adherence to approved plan.

A septic system can also be **overloaded**. Overloading can be caused by excessive water use, leaking plumbing fixtures, non-watertight septic tank, aerobic unit or lift station, and clear water from foundation drains and water softeners entering the system. Check for these things if you notice an abrupt change in the operation of your system.

Lastly, **poor system maintenance** can cause a system to fail prematurely. Have your septic tank pumped out every two to three years. This should help prevent wastewater from backing up into your house or clogging the soil absorption field.

Source: The National Small Flows Clearinghouse, Pipeline, Fall 1995, Vol. 6, No. 4

Water use around the home



SOME MAJOR SEPARATION DISTANCES:

	SOIL ABSORPTION FIELD	SEPTIC TANK OR AEROBIC UNIT
SURFACE WATERS RETENTION POND OR OTHER BODY OF WATER	50	50
SWIMMING POOL-INGROUND	25	10
WATER WELL (DRINKING, IRRIGATION)	75	50
PROPERTY LINE	10	10
BUILDING WITH FOUNDATION	20	10
BUILDING WITHOUT FOUNDATION	10	10
DECKS, FENCING, ABOVE-GROUND POOLS	10	5

HELPFUL INFORMATION

- Laundry water is classified as sewage and must be discharged to the septic system.
- Keep a record of the location of your system (The Health Department may have record of your septic location).
- The use of additives in septic tanks is unnecessary and does not eliminate the need for periodic pumping.
- Do not plant large trees in your soil absorption field area.
- Rodding or pumping out a tank and field will not correct a failing system.
- The size of a septic system depends on the type of suitable soil and the number of bedrooms in the house, or in the case of a commercial building, the projected use.
- The life span of a septic system is site dependent on many things, including, but not limited to: septic tank maintenance, volume of wastewater produced, quality of wastewater, method of wastewater application, soil type and soil conditions during construction.

TO PROLONG THE LIFE OF YOUR SYSTEM:

- Do not discharge water softeners, sump pumps, downspouts or footing drains to your septic system. This additional water can overload the system.
- Pump out the septic tank once every two to three years.
- To reduce the amount of water your system must treat and dispose of, install water conserving plumbing fixtures (toilets, showerheads, faucets).
- Check to insure that toilets do not constantly flow.
- Aerobic units must be inspected by a licensed septic contractor twice per year to insure the aerator and filter(s) are functioning properly.
- Avoid dumping grease down the drain and flushing paper toweling, disposable diapers, cigarettes, feminine products and non-degradable products down the toilet.
- If you have a garbage disposal, use it sparingly.

FOOTNOTE

This pamphlet is not meant to be all inclusive. Other types and variations of septic systems may exist. All system proposals and designs are reviewed independently for compliance with applicable regulations.